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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample and a personnel evaluation form are also included. (AG)

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June 1970

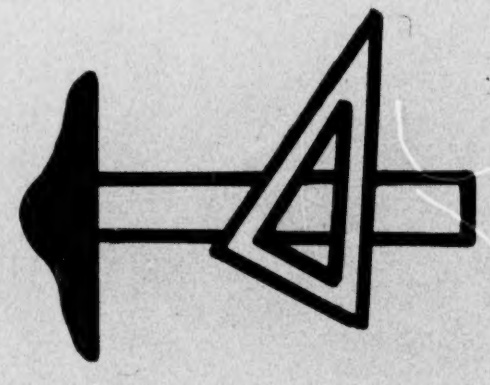
U.S. Training and Employment Service
Technical Report
S-266R

Development of USTES

APTITUDE TEST BATTERY FOR

DRAFTSMAN

U.S. DEPARTMENT OF LABOR
Manpower Administration



TM 001 912

Technical Report on Development of USTES Aptitude Test Battery

For . . . . . .

Draftsman, Architectural (profess. & kin.) 001.281
Draftsman, Civil (profess. & kin.) 005.281
Draftsman, Geological (petrol. production) 010.281
Draftsman, Mechanical (profess. & kin.) 007.281
Draftsman, Structural (profess. & kin.) 005.281
Detailer (profess. & kin.) 017.281

S-266R

(Developed in Cooperation with the California, Michigan, and Minnesota State Employment Services)

U.S. Department of Labor
Manpower Administration

June 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

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GATB Study # 2794, 2795, 2796, 2797, 2649, 2697, 2793, and 2804

Development of USTES Aptitude Test Battery

For

Draftsman, Civil (profess. & kin.) 005.281-014
Draftsman, Geological (petrol. production) 010.281-018
Draftsman, Structural (profess. & kin.) 005.281-018
Detailer (profess. & kin.) 017.281-034

S-266R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupations of Draftsman, Civil (profess. & kin.) 005.281-014, Draftsman, Geological (petrol. production) 010.281-018, Draftsman, Structural (profess. & kin.) 005.281-018, and Detailer (profess. & kin.) 017.281-034. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Aptitude	90
S - Spatial Aptitude	115
P - Form Perception	90
Q - Clerical Perception	100

Research Summary - Validation Sample

Sample:

232 workers (215 men and 17 women) employed as Draftsmen and Detailers in California. The sample included 5 Negroes, 29 Spanish Americans, 21 Orientals, and 177 nonminority subjects. (Sub-group analysis is shown in Appendix A.)

Criterion:

Supervisory ratings.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi coefficient = .38 ($P/2 < .0005$)

Effectiveness of Norms:

Only 68% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 83% would have been good workers. 32% of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 17% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	68%	83%
Poor Workers	32%	17%

SAMPLE DESCRIPTION

Size:

N = 232

Occupational Status:

Employed workers.

Work Setting:

Workers were employed by companies in California listed in Appendix B.

Employer Selection Requirements:

Education: High school graduation with courses in mathematics generally required.

Previous Experience: Some companies require two years work experience.

Tests: None used.

Other: Personal interview. Some companies require experienced applicants to present samples of their work.

Principal Activities:

The job duties for each worker are comparable to those shown in Appendix D.

Minimum Experience:

All workers in the final sample had at least three months job experience.

TABLE 2

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education, and Experience (N = 232)

	Mean	SD	Range	r
Age (years)	37.7	9.6	21-64	.114
Education (years)	13.8	1.7	8-18	-.018
Experience (months)	133.6	86.4	3-468	.235**

**Significant at the .01 level.

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002B, were administered during the period from July 1966 to 1970. The Research Questionnaire-Background was administered to the 52 Detailers involved in the study.

CRITERION

The criterion data consisted of supervisory ratings of job proficiency made at approximately the same time as the tests were administered with a time interval of two weeks between the two ratings.

Rating Scale:

Two adaptations of Form SP-21, "Descriptive Rating Scale" were used. An eight-item scale was used for the subsample of Detailers. A ten-item scale was used for all other subjects. (See Appendix C for rating scales.) The scores for individuals rated on the eight-item scale were multiplied by 1.25 to make the scores comparable to scores on the ten-item scale.

Reliability:

A reliability coefficient of .94 was obtained between the initial ratings and the re-ratings, indicating a significant relationship. The final criterion score consists of the combined scores of the two ratings.

Criterion Score Distribution:

Possible Range:	20-100
Actual Range:	27-100
Mean:	67.2
Standard Deviation:	16.5

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 32% of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers." The criterion critical score is 58.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Aptitude P which does not have a significant correlation with the criterion was considered for inclusion in the norms because the qualitative analysis indicated that the aptitude might be important for the job duties and the sample had a relatively high mean score on this aptitude. Tables 3, 4 and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis

(Based on the job analysis, the aptitudes indicated appear to be important to the work performance)

G - General Learning Ability	Required in utilizing knowledge of engineering procedures, methods of fabrication and shop practices; in using technical hand books and catalogs; and in interpreting blueprints, sketches, specifications and related engineering information.
N - Numerical Aptitude	Required in determining strength calculations and computing degrees of bends, sizes of required parts, tolerances, fits and dimensions.
S - Spatial Aptitude	Required in interpreting blueprints and sketches, preparing detailed drawings from rough sketches received from design engineer, and making accurate scale drawings of parts from specifications noted on preliminary layout or rough sketches.
P - Form Perception	Required to differentiate minor variances in shading; and perspective to determine angle, deviation, and dimensions.
Q - Clerical Perception	Required to observe fine detail in checking work to perceive errors. Required to use mathematical tables and handbooks.

TABLE 4

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB (N = 232)

	Mean	SD	Range	r
G - General Learning Ability	115.6	12.6	82-154	.463**
V - Verbal Aptitude	107.1	12.4	70-149	.322**
N - Numerical Aptitude	110.3	13.9	71-155	.445**
S - Spatial Aptitude	120.1	14.2	78-163	.229**
P - Form Perception	116.2	18.7	59-170	.126
Q - Clerical Perception	118.2	14.2	87-179	.209**
K - Motor Coordination	107.4	18.0	53-159	.112
F - Finger Dexterity	91.5	18.1	29-137	.033
M - Manual Dexterity	100.4	21.2	43-157	.024

** Significant at the .01 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data: Important	X		X	X	X	X			
Irrelevant									
Relatively High Mean	X			X	X	X			
Relatively Low Standard Deviation	X	X	X						
Significant Correlation with Criterion	X	X	X	X		X			
Aptitudes to be Considered for Trial Norms	X	X	X	X	X	X			

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of the degree to which trial norms consisting of various combinations of aptitudes G, V, N, S, P and Q at trial cutting scores were able to differentiate between the 68% of the sample considered to be good workers and the 32% of the sample considered to be poor workers. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For four-aptitude trial norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about one-third of the sample; for two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample. The phi coefficient was used as a basis for comparing trial norms. Norms of N-90, S-115, P-90, and Q-100 provided optimum differentiation for the occupations of Draftsman, Civil (profess. & kin.) 005.281-014; Draftsman, Geological (petrol. production) 010.281-018; Draftsman, Structural (profess. & kin.) 005.281-018; and Detailer (profess. & kin.) 017.281-034. The validity of these norms is shown in Table 6 and is indicated by a phi coefficient of .38 (statistically significant at the .0005 level).

TABLE 6

Concurrent Validity of Test Norms
N-90, S-115, P-90 and Q-100

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	40	118	158
Poor Workers	49	25	74
Total	89	143	232

Phi Coefficient = .38 Chi Square (X^2_y) = 33.9
Significance Level = P/2 $<$.0005

Sub-Group Analysis of the Norms

The data from this validation study, as well as the data from two of the check studies, have been analyzed for minority group differences. The analysis is reported in Appendix A.

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP-34 which is shown in Section II of the 1970 edition of the Manual for the General Aptitude Test Battery. A phi coefficient of .28 is obtained when the OAP-34 norms of N-90, S-95 and P-90 are applied to the validation sample. When the OAP-34 norms are applied to the combined validation and cross validation samples (N = 537), a phi coefficient of .22 is obtained.

CHECK STUDY RESEARCH SUMMARY SHEET FOR S-266R

S-266R GATB Study # 2793

Draftsman, Civil (profess. & kin.) 005.281-014

Check Study #1 Research Summary

Sample

60 (6 female and 54 male) Civil Draftsmen employed in California. The subjects were State and city employees who had been selected for employment by civil service test scores. 2 subjects were Negro, 7 subjects were Spanish American, 14 subjects were Oriental, and 37 subjects were nonminority group persons.

TABLE 7

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education, Experience and Aptitudes of the GATB. N = 60

	Mean	SD	Range	r
Age (years)	33.6	7.9	22-52	-.226
Education (years)	13.7	1.1	12-16	-.067
Experience (months)	88.0	65.4	12-312	-.036
G - General Learning Ability	119.5	13.0	91-156	.488**
V - Verbal Aptitude	111.1	12.5	88-149	.332**
N - Numerical Aptitude	116.3	14.9	80-148	.436**
S - Spatial Aptitude	122.1	15.8	88-156	.395**
P - Form Perception	124.3	21.5	67-171	.415**
Q - Clerical Perception	120.5	15.8	93-165	.301*
K - Motor Coordination	113.4	20.3	62-155	.149
F - Finger Dexterity	96.7	17.1	59-151	-.009
M - Manual Dexterity	108.0	20.8	65-167	.186

*Significant at the .05 level
**Significant at the .01 level

Criterion:

Supervisory ratings using the ten-item scale shown in Appendix C were collected in 1968.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Concurrent Validity:

Phi coefficient = .33

Effectiveness of Norms:

Only 65% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-266R norms, 78% would have been good workers. 35% of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the S-266R norms, only 22% would have been poor workers. The effectiveness of the norms when applied to this independent sample is shown graphically in Table 8:

TABLE 8

Effectiveness of S-266R Norms on Check Study Sample #1

	Without Tests	With Tests
Good Workers	65%	78%
Poor Workers	35%	22%

TABLE 9

Concurrent Validity of S-266R Norms on Check Study Sample #1

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	8	31	39
Poor Workers	12	9	21
Total	20	40	60

Phi Coefficient (ϕ) = .33 Chi Square (X^2_y) = 6.7

Significance Level = P/2 $<$.005

CHECK STUDY RESEARCH SUMMARY SHEET FOR S-266R

S-266R GATB Study # 2804

Draftsman, Mechanical (profess. & kin.) 007.281-014

Check Study #2 Research Summary

Sample

130 (1 female and 129 male) MDTA Mechanical Draftsman trainees enrolled at various training facilities throughout the State of Minnesota. Minority group data were not available on one class of ten trainees since data were obtained prior to the policy of recording such information. Of the remaining 120 trainees, 2 were identified as Negroes, 7 as American Indians, 1 as Mexican American, and 1 as Spanish American; the remaining 109 were nonminority group persons.

TABLE 10

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criteria (r) for Age, Education, Cultural Exposure and Aptitudes of the GATB. Criterion 1 -- Instructors' Ratings (N = 130); Criterion 2 -- Work Sample (N = 63)

	Mean (N=130)	SD (N=130)	Range (N=130)	r_1 (N=63)	r_2 (N=63)
Age (years)	24.4	6.5	17-48	.123	-.159
Education (years)	11.6	1.0	9-14	.155	.178
Cultural Exposure	1.7	1.6	0-6	.080	.088
G - General Learning Ability	113.9	9.4	85-140	.408**	.299*
V - Verbal Aptitude	104.0	12.0	68-137	.304**	.098
N - Numerical Aptitude	110.3	11.0	69-136	.287**	.094
S - Spatial Aptitude	123.8	13.9	91-166	.200*	.229
P - Form Perception	116.3	13.2	83-151	.227**	.089
Q - Clerical Perception	111.2	12.1	84-148	.252**	.044
K - Motor Coordination	101.5	17.9	45-169	.202*	-.089
F - Finger Dexterity	103.1	17.1	59-149	.124	.251*
M - Manual Dexterity	104.9	20.0	53-164	.163	-.139

*Significant at the .05 level

**Significant at the .01 level

Criterion:

Instructors' ratings collected in 1970. (A work sample drawing was obtained for 63 subjects. This criterion was not used in the validation analysis because it was not available for all subjects.)

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Concurrent Validity:

Phi coefficient = .24

Effectiveness of Norms:

Only 68% of the nontest-selected students used for this study were good students; if the students had been test-selected with the S-266R norms, 79% would have been good students. 32% of the nontest-selected students used for this study were poor students; if the students had been test-selected with the S-266R norms, only 21% would have been poor students. The effectiveness of the norms when applied to this independent sample is shown graphically in Table 11:

TABLE 11

Effectiveness of S-266R Norms on Check Study Sample #2

	Without Tests	With Tests
Good Workers	68%	79%
Poor Workers	32%	21%

TABLE 12

Concurrent Validity of S-266R Norms on Check Study Sample #2

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	32	57	89
Poor Workers	26	15	41
Total	58	72	130

Phi Coefficient (ϕ) = .24 Chi Square (X^2_y) = 7.5

Significance Level = P/2 $<$.005

CHECK STUDY RESEARCH SUMMARY SHEET FOR S-266R

S-266R GATB Study # 2649 and 2697

Draftsman, Architectural (profess. & kin.) 001.281-010
Draftsman, Mechanical (profess. & kin.) 007.281-014

Check Study #3 Research Summary

Sample

1) 52 (1 female and 51 male) Architectural Drafting students at Ferris State College, Big Rapids, Michigan. 2) 63 male Mechanical Drafting students at the same school. This study was conducted prior to the requirement of providing minority group information. Therefore, minority group status is unknown.

TABLE 13

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion for Age, Education and Aptitudes of the GATB. N = 52 Draftsman, Architectural (r_1); N = 63, Draftsman, Mechanical (r_2)

	Mean (N=115)	SD (N=115)	Range (N=115)	r_1 (N=52)	r_2 (N=63)
Age (years)	21.4	3.4	19-51	.253	.172
Education (years)	14.0	.4	14-15	.102	.048
G - General Learning Ability	120.1	9.4	93-141	.319*	.365**
V - Verbal Aptitude	103.5	9.6	78-129	.281*	.414**
N - Numerical Aptitude	117.2	9.8	90-139	.188	.243
S - Spatial Aptitude	132.0	13.9	91-163	.184	.202
P - Form Perception	128.2	15.6	91-166	.060	.159
Q - Clerical Perception	111.6	13.9	82-161	.204	.223
K - Motor Coordination	111.6	13.6	78-140	-.037	.189
F - Finger Dexterity	109.6	16.4	69-149	-.019	-.051
M - Manual Dexterity	127.2	18.9	80-178	.156	.073

*Significant at the .05 level
**Significant at the .01 level

Criterion:

Total grade-point average collected in 1967.

Design:

Concurrent (test and criterion data were collected at approximately the same time.)

Concurrent Validity:

Phi coefficient = .21

Effectiveness of Norms:

Only 67% of the nontest-selected students used for this study were good students; if the students had been test-selected with the S-266R norms, 73% would have been good students. 33% of the nontest-selected students used for this study were poor students; if the students had been test-selected with the S-266R norms, only 27% would have been poor students. The effectiveness of the norms when applied to this independent sample is shown graphically in Table 14:

TABLE 14

Effectiveness of S-266R Norms on Check Study Sample #3

	Without Tests	With Tests
Good Workers	67%	73%
Poor Workers	33%	27%

TABLE 15

Concurrent Validity of S-266R Norms on Check Study Sample #3

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	14	63	77
Poor Workers	15	23	38
Total	29	86	115

Phi Coefficient (ϕ) = .21 Chi Square (X^2_y) = 5.0

Significance Level = P/2 < .025

APPENDIX A

Sub-Group Analysis of the Norms

Table 16 shows the mean aptitude and criterion scores for the 55 minority workers in the validation sample (5 Negroes, 29 Spanish Americans and 21 Orientals) and the 177 nonminority group workers in the validation sample. Table 17 shows the relationship between the S-266R norms and the criterion for these two samples.

TABLE 16

Mean Aptitude and Criterion Scores of Minority and Nonminority Draftsmen in S-266R Validation Sample

	G	V	N	S	P	Q	K	F	M	Criterion
Nonminority [a]	116.0	107.7	110.2	120.1	114.4	117.9	104.7	89.3	97.9	67.4
Minority [b]	114.1	104.9	110.6	120.0	122.0	119.1	115.8	98.6	108.5	66.5

[a] N = 177

[b] N = 5 Negroes, 29 Spanish Americans and 21 Orientals

TABLE 17

Relationship Between Test Norms (N-90, S-115, P-90, Q-100) and Dichotomized Criterion Draftsmen Validation Study

	N	ø	P/2
Minority	55[a]	.31	.025
Nonminority	177	.39	.0005
Total	232	.38	.0005

[a] 5 Negroes, 29 Spanish Americans and 21 Orientals

Table 18 shows the mean aptitude scores for the 38 Spanish Americans, the 35 Orientals, the 89 minority group individuals (Negroes and American Indians, as well as Spanish Americans and Orientals) and the 333 nonminority group members in the total sample available for the validation study and check studies 1 and 2. (Minority group information is not available for check study #3. Mean criterion scores are not shown because of the different criteria used.)

TABLE 18

Mean Aptitude Scores of Minority and Nonminority Draftsmen on S-266R Validation and Check Study Samples

	G	V	N	S	P	Q	K	F	M
Spanish American (N = 38)	114.0	105.5	109.2	120.5	122.0	114.7	110.8	98.8	109.1
Oriental (N = 35)	117.3	107.0	117.9	121.4	129.2	123.9	121.3	101.1	112.3
Total Minority (N = 89)[a]	114.6	105.3	112.0	121.7	122.9	118.3	112.6	99.1	108.3
Nonminority (N = 333)	115.9	107.1	110.9	121.4	115.9	115.6	104.5	94.9	101.4

[a] Includes 9 Negroes and 7 American Indians as well as individuals shown in first two rows of table.

Table 19 shows the relationship between the S-266R norms and the criterion for these same samples.

TABLE 19

Relationship Between Test Norms (N-90, S-115, P-90, Q-100) and Dichotomized Criterion

Draftsmen Validation and Cross Validation Studies Combined

	N	ø	P/2
Spanish American	38	.39	.01
Oriental	35	.20	.15
Total Minority	89[a]	.32	.0005
Nonminority	333	.34	.0005
Grand Total	422	.34	.0005

[a] Includes 9 Negroes and 7 American Indians as well as individuals shown in first two rows of table.

The S-266R norms provide satisfactory prediction for minority and non-minority group workers for both the validation sample and the combined sample (validation plus the two cross validation studies in which minority group status is known). In Table 19 the phi coefficients for the small samples of Spanish Americans and Oriental workers are also shown. The phi coefficient for the Spanish Americans is significant but the coefficient for the Orientals is not significant. While no definite conclusions can be made about the predictive value of S-266R norms when applied to specific minority groups due to limited sample sizes, the norms do appear to be predictive of job performance of minority group members as a whole. The percentage of minority and nonminority workers in the validation sample that did not qualify on the test battery but were satisfactory workers was approximately the same (18% minority and 17% nonminority). A slightly larger percentage of nonminority group members (20%) than minority group individuals (17%) in the overall sample did not qualify on the test battery but were satisfactory workers. These differences are not significant.

APPENDIX B

Organizations Contributing Samples for USTES Technical Report S-266R

Validation Sample

1.	A. C. MARTIN AND ASSOCIATES	Los Angeles, California
2.	ALDERMAN AND SWIFT CONSULTING ENGINEERS	South Pasadena, California
3.	ATLANTIC RICHFIELD COMPANY	Long Beach, California
4.	AMERADA PETROLEUM CORPORATION	Los Angeles, California
5.	BECHTEL CORPORATION	Vernon, California
6.	BEN SCHMID STRUCTURAL ENGINEER	Pasadena, California
7.	BETHLEHEM STEEL COMPANY	Vernon, California
8.	BLUE DIAMOND CONCRETE MATERIALS, DIVISION OF THE FLINTKOTE COMPANY	Los Angeles, California
9.	BRANDOW AND JOHNSON ASSOCIATES	Los Angeles, California
10.	DANIEL, MANN, JOHNSON, & MENDENHALL ENGINEERS	Los Angeles, California
11.	ENGINEERING SERVICE CORPORATION	Los Angeles, California
12.	FLUOR CORPORATION, LTD.	Los Angeles, California
13.	FONTANA STEEL CORPORATION	Fontana, California
14.	GOLDEN STATE STEEL	Santa Fe Springs, California
15.	HUMBLE OIL AND REFINING COMPANY	Los Angeles, California
16.	JOHN A. MARTIN, STRUCTURAL ENGINEER	Los Angeles, California
17.	JOHNSON AND NIELSON CONSULTING ENGINEERS	Los Angeles, California
18.	KING-BENIOFF-STEINMAN-KING CONSULTING ENGINEERS	Sherman Oaks, California
19.	LONG BEACH DEPARTMENT OF OIL PROPERTIES	Long Beach, California
20.	LOS ANGELES CITY DEPARTMENT OF PUBLIC WORKS, BRIDGE DIVISION	Los Angeles, California
21.	MARATHON OIL COMPANY	Los Angeles, California
22.	Mc INTYRE AND QUIROS, INC.	Monterey Park, California
23.	METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA	Los Angeles, California
24.	MOBILE OIL CORPORATION	Los Angeles, California
25.	MONTGOMERY CONSTRUCTION ENGINEERS, INC.	Pasadena, California
26.	QUINTON ENGINEERING	Los Angeles, California
27.	RALPH M. PARSONS COMPANY	Los Angeles, California
28.	ROEMISH STEEL	Los Angeles, California
29.	RYERSON, JOS. T. & SONS	Los Angeles, California
30.	SHELL OIL COMPANY	Los Angeles, California
31.	SIGNAL OIL AND GAS COMPANY	Los Angeles, California
32.	SOULE STEEL COMPANY	Los Angeles, California
33.	SOUTHERN PACIFIC COMPANY	Los Angeles, California
34.	STANDARD OIL COMPANY, WESTERN OPERATIONS	La Habla, California
35.	SUBURBAN WATER SYSTEMS	Valinda, California
36.	TEXACO, INCORPORATED	Los Angeles, California
37.	THUMS LONG BEACH COMPANY	Long Beach, California
38.	UNION OIL COMPANY OF CALIFORNIA	Los Angeles, California
39.	UNITED CONCRETE PIPE CORPORATION	Baldwin Park, California
40.	WHEELER AND GRAY CONSULTING ENGINEERS	Los Angeles, California

Check Study #1 Sample

1.	CALIFORNIA STATE DIVISION OF WATER RESOURCES	Los Angeles, California
2.	CITY OF SIGNAL HILL	Signal Hill, California
3.	LOS ANGELES CITY DEPARTMENT OF PUBLIC WORKS	Los Angeles, California
4.	LOS ANGELES CITY DEPARTMENT OF WATER AND POWER	Los Angeles, California

Check Study #2 Sample

1.	ALBERT LEA PUBLIC SCHOOLS	Minnesota
2.	DETROIT LAKES VOCATIONAL-TECHNICAL SCHOOL	Minnesota
3.	DULUTH COMPREHENSIVE FACILITY	Minnesota
4.	MINNEAPOLIS VOCATIONAL-TECHNICAL SCHOOL	Minnesota
5.	ST. PAUL VOCATIONAL-TECHNICAL SCHOOL	Minnesota

Check Study #3 Sample

1.	FERRIS STATE COLLEGE	Big Rapids, Michigan

APPENDIX C

RATING SCALES

SP-21
Adaptation Nov. 68

Company _____

Location _____

_____

Rater _____

Title _____

DESCRIPTIVE RATING SCALE
(For Aptitude Test Development Studies)

Score_____

RATING SCALE FOR _____
D. O. T. Title and Code

DIRECTIONS: Please read Form SP-20, "Suggestions to Raters," and then fill in the items listed below. In making your ratings, only <u>one</u> box should be checked for each question.

Name of Worker (print) _____
(Last) (First)

Sex: Male ____ Female ____ Experience: Length of time on job _____
(In Months)

Company Job Title: _____

How often do you see this worker in a work situation?

☐ See him at work all the time.

☐ See him at work several times a day.

☐ See him at work several times a week.

☐ Seldom see him in work situation.

How long have you worked with him?

☐ Under one month.

☐ One to two months.

☐ Three to five months.

☐ Six months or more.

A. How much work can he get done? (Worker's ability to make efficient use of his time and to work at high speed.)

☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.

☐ 2. Capable of low work output. Can perform at a slow pace.

☐ 3. Capable of fair work output. Can perform at an acceptable but not a fast pace.

☐ 4. Capable of high work output. Can perform at a fast pace.

☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

B. How good is the quality of his work? (Worker's ability to do high-grade work which meets quality standards.)

☐ 1. Performance is inferior and almost never meets minimum quality standards.

☐ 2. The grade of his work could stand improvement. Performance is usually acceptable but somewhat inferior in quality.

☐ 3. Performance is acceptable but usually not superior in quality.

☐ 4. Performance is usually superior in quality.

☐ 5. Performance is almost always of the highest quality.

C. How accurate is he in his work? (Worker's ability to avoid making mistakes.)

☐ 1. Makes very many mistakes. Work needs constant checking.

☐ 2. Makes frequent mistakes. Work needs more checking than is desirable.

☐ 3. Makes mistakes occasionally. Work needs only normal checking.

☐ 4. Makes few mistakes. Work seldom needs checking.

☐ 5. Rarely makes a mistake. Work almost never needs checking.

D. How much does he know about his job? (Worker's understanding of the principles, equipment, materials and methods that have to do directly or indirectly with his work.)

☐ 1. Has very limited knowledge. Does not know enough to do his job adequately.

☐ 2. Has little knowledge. Knows enough to "get by."

☐ 3. Has moderate amount of knowledge. Knows enough to do fair work.

☐ 4. Has broad knowledge. Knows enough to do good work.

☐ 5. Has complete knowledge. Knows his job thoroughly.

E. How much aptitude or facility does he have for this kind of work? (Worker's adeptness or knack for performing his job easily and well.)

☐ 1. Has great difficulty doing his job. Not at all suited to this kind of work.

☐ 2. Usually has some difficulty doing his job. Not too well suited to this kind of work.

☐ 3. Does his job without too much difficulty. Fairly well suited to this kind of work.

☐ 4. Usually does his job without difficulty. Well suited to this kind of work.

☐ 5. Does his job with great ease. Exceptionally well suited for this kind of work.

F. How large a variety of job duties can he perform efficiently? (Worker's ability to handle several different operations in his work.)

☐ 1. Cannot perform different operations adequately.

☐ 2. Can perform a limited number of different operations efficiently.

☐ 3. Can perform several different operations with reasonable efficiency.

☐ 4. Can perform many different operations efficiently.

☐ 5. Can perform an unusually large variety of different operations efficiently.

G. How resourceful is he when something different comes up or something out of the ordinary occurs? (Worker's ability to apply what he already knows to a new situation.)

☐ 1. Almost never is able to figure out what to do. Needs help on even minor problems.

☐ 2. Often has difficulty handling new situations. Needs help on all but simple problems.

☐ 3. Sometimes knows what to do, sometimes doesn't. Can deal with problems that are not too complex.

☐ 4. Usually able to handle new situations. Needs help on only complex problems.

☐ 5. Practically always figures out what to do himself. Rarely needs help, even on complex problems.

H. How many practical suggestions does he make for doing things in better ways? (Worker's ability to improve work methods.)

☐ 1. Sticks strictly with the routine. Contributes nothing in the way of practical suggestions.

☐ 2. Slow to see new ways to improve methods. Contributes few practical suggestions.

☐ 3. Neither quick nor slow to see new ways to improve methods. Contributes some practical suggestions.

☐ 4. Quick to see new ways to improve methods. Contributes more than his share of practical suggestions.

☐ 5. Extremely alert to see new ways to improve methods. Contributes an unusually large number of practical suggestions.

SP-21
Adaption June, 1966

DESCRIPTIVE RATING SCALE
(For Aptitude Test Development Studies)

SCORE_____

RATING SCALE FOR_____
D. O. T. Title and Code

Directions: Please read the sheet "Suggestions to Raters" and then fill in the items listed below. In making your ratings, only one box should be checked for each question.

Name of worker_____
(Last) (First) (Initial)

How long have you supervised this worker and how familiar are you with his job performance?

- ☐ Under one month.
- ☐ One to two months.
- ☐ Three to five months.
- ☐ Six months or more.

- ☐ See him at work all the time.
- ☐ See him at work several times a day.
- ☐ See him at work several times a week.
- ☐ Seldom see him in work situation.

Rated by_____ _____ _____
(Signature) (Title) (Date)

A. How much work can he accomplish? (Volume of <u>acceptable</u> work produced.)

☐ 1. Capable of low work output. Can perform only at a less that satisfactory rate.

☐ 2. Capable of fair work output. Can perform at a satisfactory rate.

☐ 3. Capable of good work output. Can perform at a fairly fast rate.

☐ 4. Capable of high work output. Can perform at a very fast rate.

☐ 5. Capable of extremely high work output. Can perform at highest rate.

B. How accurate is he in his work? (The correctness with which work is performed. Freedom from errors.)

☐ 1. Makes many errors. Work needs constant checking.

☐ 2. Makes frequent errors. Work needs more checking than is desirable.

☐ 3. Makes errors occasionally. Work needs only normal checking.

☐ 4. Makes few errors. Work seldom needs checking.

☐ 5. Rarely makes an error. Work almost never needs checking.

C. How good is the quality of his work? (Nature of workmanship. Ability to do high-grade work which meets quality standards.)

☐ 1. Performance is usually acceptable, but only meets minimum standards.

☐ 2. Performance is acceptable, but usually not superior in quality.

☐ 3. Performance is usually superior in quality.

☐ 4. Performance is almost of the highest quality.

☐ 5. Performance is outstanding, meets maximum standards.

D. How much does he know about his work? (Understanding of the fundamentals that have to do directly or indirectly with his immediate and related jobs.)

☐ 1. Has very limited knowledge of fundamentals. Does not know enough to do his work adequately.

☐ 2. Has limited knowledge of fumdamentals. Knows enough to "get by".

☐ 3. Has fair knowledge of fundamentals. Knows enough to do adequate work.

☐ 4. Has good knowledge of fundamentals. Knows enough to do good work.

☐ 5. Has excellent knowledge of fundamentals. Outstanding in work.

E. How much aptitude or facility does he have for this kind of work? (Natural adeptness or knack for performing work easily and well.)

☐ 1. Has great difficulty doing his work. Not suited to this kind of work.

☐ 2. Usually has some difficulty doing his work. Not too well suited to this kind of work

☐ 3. Does his work without too much difficulty. Fairly well suited to this kind of work.

☐ 4. Usually does his work without difficulty. Well suited to this kind of work.

☐ 5. Does his work with great ease. Exceptionally well suited to this kind of work.

F. How complete is his understanding of mathematics associated with his work? (Ability to make necessary computations required to perform his work.)

☐ 1. Fair understanding. Able to deal with the less difficult mathematics involved in his work.

☐ 2. Satisfactory understanding. Able to deal with most of the mathematics involved in his work.

☐ 3. Very good understanding. Able to deal with all but the most difficult mathematics involved in his work.

☐ 4. Excellent understanding. Able to deal with some of the most difficult mathematics involved in his work.

☐ 5. Superior understanding. Able to deal with all of the mathematics involved in his work.

G. How accurately and well does he analyze source data? (Ability to mentally separate information contained in source data into its component elements for drafting.)

☐ 1. Has great difficulty in analyzing and distinguishing component elements.

☐ 2. Usually has some difficulty in analyzing and distinguishing component elements

☐ 3. Analyzes and distinguishes component elements without too much difficulty.

☐ 4. Analyzes and distinguishes component elements with ease.

☐ Analyzes and distinguishes component elements with the greatest of ease.

H. How much judgment does he exercise? (Ability to analyze a problem, grasp essentials, and make a decision to reach a sound conclusion.)

☐ 1. Can't reach a decision. Almost never is able to figure out what to do. Needs help on even minor problems.

☐ 2. Makes quick, erratic decisions. Often has difficulty and needs help on all but simple problems.

☐ 3. Eventually comes to right conclusion. Deals with most problems that are not too complex.

☐ 4. Often makes right decisions at the right time. Needs help only on complex problems.

☐ 5. Always makes right decisions at the right time. Rarely needs help, even on complex problems.

I. How well does he check his finished work? (Ability to perceive errors in work and to make correct revisions.

☐ 1. Misses major errors. Work needs constant checking by supervisor.

☐ 2. Has difficulty locating errors. Work needs more checking than is desirable by supervisor.

☐ 3. Misses some errors. Work needs only normal checking by supervisor.

☐ 4. Checks work well. Seldom needs checking by supervisor.

☐ 5. Is very observant. Work almost never needs checking by supervisor.

J. Considering all the factors just rated, and only these factors, how acceptable is his work? ("All-around ability to do his work.)

☐ 1. Performance somewhat inferior. Prefer not to have this worker.

☐ 2. Performance only generally acceptable. Hesitant to have this worker.

☐ 3. Performance is acceptable. Satisfied to have this worker.

☐ 4. Performance usually excellent. Pleased to have this worker.

☐ 5. Performance is outstanding. Particularly desire to have this worker.

APPENDIX D

Work Performed and Course Content

Job Title: Draftsman, Architectural (profess. & kin.) 001.281-010

(Cross Validation Study III)

Course Summary: This curriculum is designed to train architectural draftsmen to think, speak and read about problems and ideas of the client, designer, architect, fabricator, engineer and contractor, and translate these ideas into working drawings with a conciseness and clearness which will enable the builder to concretely produce the precise concept of the architect.

Drawing courses include typical problems encountered by the architectural draftsman in industry. Graduate architects with industrial experience offer instruction. Because of architecture's diverse nature, courses are given in mathematics, communication skills and architectural office procedure.

Required Course Curriculum: The following courses must be completed by a student before Ferris State College will grant a certificate in Architectural Drafting.

Non-Core Curriculum

Technical Mathematics (Algebra) - 5 hours/week (1st quarter)
Technical Mathematics (Slide Rule) - 2 hours/week (1st quarter)
Communications I & II - 3 hours/week (1st & 2nd quarters)
Physical Education - 2 hours/week (1st, 2nd, and 3rd quarters)
Continuing Orientation - 1 hour/week (1st quarter)
Technical Mathematics (Geometry) - 3 hours/week (2nd quarter)
Survey of Graphic Reproduction Processes - 3 hours/week (2nd quarter)
Health Education - 3 hours/week (2nd quarter)
Technical Mathematics (Algebra & Trigonometry) - 5 hours/week (3rd quarter)
Mechanics & Heat - 7 hours/week (3rd quarter)
Electricity, Sound & Light - 7 hours/week (4th quarter)
Political Science - 5 hours/week (5th quarter)
Elementary Typing - 5 hours/week (5th quarter)
Social Science (Man & Society) - 5 hours/week (6th quarter)
Everday Law - 4 hours/week (6th quarter)

Core Curriculum

Basic Architectural Projections - 17 hours/week (1st quarter)
Materials of Construction I - 3 hours/week (1st quarter)
Advanced Architectural Projections - 17 hours/week (2nd quarter)
Materials of Construction II - 3 hours/week (2nd quarter)
History of Architecture - 3 hours/week (2nd quarter)
Preliminary Drawings - 17 hours/week (3rd quarter)
Design Fundamentals - 3 hours/week (3rd quarter)
Residential Drafting - 20 hours/week (4th quarter)
Mechanical Equipment for Buildings - 3 hours/week (4th quarter)

Core Curriculum cont'd

Mechanics and Strength of Materials - 3 hours/week (4th quarter)
Working Drawings I - 20 hours/week (5th quarter)
Structural Design - 3 hours/week (5th quarter)
Specifications - 2 hours/week (th quarter)
Working Drawings II - 20 hours/week (6th quarter)
Architectural Office Practice - 2 hours/week (6th quarter)

Job Title: Draftsman, Civil (profess. & Kin.) 005.281-014

(Validation Study and Cross Validation Study I)

Work Performed: Receives engineering specifications and data, survey field notes, rough sketches, and oral or written instructions. Analyzes engineering specifications and data for technical and mathematical content, checks and reduces survey field notes to detailed descriptive and mathematical specifications, or prepares detailed, freehand sketch based upon data received from rough sketch or oral and written instructions. Checks existing plans, drawings, and maps for possible source of correlative data to be incorporated with new work; or for use in alteration, maintenance, and operation of completed projects. Computes specifications and data received; using calculating machine and trigonometric, logarithmic, and curve data tables; to obtain dimensions for distances, ties, angles, curves, grades, slopes, elevations, traverses, closures, alignments, and stationing. Determines or ascertains scale to be used by analysis and computation of specifications and data, by inspection of existing plans and drawings, through consultations with engineer responsible for project, or from specifications received from chief draftsman. Organizes and arranges data into logical sequence for drafting. Obtains and fastens on drafting table specified size and type of drawing paper, cloth, or vellum. Draws and plots detailed graphic representations of data to scale in conformity with specifications, computed dimensions, and spatial relationships, using T-squares, straight edges, triangles, compasses, scribers, curve templates, and drafting pens and pencils. Delineates and identifies dimensions drawn with engineering symbols and mathematical data. Letters drawing as specified to identify project and component parts, using freehand and/or lettering machine. Checks completed work for accuracy and submits drawing to supervisor or project engineer. Performs related clerical work to file drawings, tabulate reports and data, and index survey field notes. Occasionally, if expected to carry through all phases of drafting job, visits work site to collect or check measurements; scans catalogues for materials used on project; or searches out pertinent government regulations, codes, and ordinances, which apply to or modify specifications and data to be drafted.

Job Title: Draftsman, Geological (petrol. production) 010.281-018

(Validation Sample)

Work Performed: Receives specifications, land survey notes and sketches, aerial photographs, electric logs, and well cores. Examines data for geological content.

Reduces land survey notes and sketches to descriptive specifications. Interprets aerial photographs and ascertains distribution and extent of surface formations. Studies electric log strips, sets up strips as instructed by geologist, and ascertains interrelationships of sub-surface structures. Visually inspects well cores and determines nature of each core section in terms of type of rock, texture, matrix, porosity, permeability, or faults. Determines scale to be used by analysis of data, consultations with geologist, or from specifications received from chief draftsman. Organizes and arranges data into logical sequence for drafting. Draws and plots detailed graphic representations of data to scale, using T-squares, triangles, straight-edges, compass, dividers, scribers, and drafting pens and pencils. Delineates and identifies dimensions drawn with geological symbols and color shading. Letters drawing as specified to identify work, using freehand and/or lettering machine. Checks completed work for accuracy and submits drawing to supervisor or geologist. Researches company property records and legal documents for information on mineral right owners, locations of existing and abandoned wells and drafts data obtained on new or existing base maps. Checks government maps and drawings, company records, and survey notes to obtain information on man-made structures and roads. Drafts information obtained on base maps. Receives requests from geologist for drafting supplementation to reports and publications. Reviews request and assembles existing drawings or prepares special drawings for submission to geologist. Performs related clerical work to file drawings, tabulate reports and data, and index survey field notes.

Job Title: Draftsman, Mechanical (profess. & kin.) 007.281-014

(Cross Validation Study II)

Course Content:

	Hours
Basic Drafting Mechanics Introduction and study of techniques, equipment, and processes common to the engineering drawing province. The student is acquainted with the manipulation and care of instruments and tools with which he will be working.	100
Fundamental Drawing Principles Basic graphic arts concepts are studied. Major topics are orthographic projection, multi-view, pictorial and perspective drawings; auxiliaries, sectioning, conventions, and developments.	300
Lettering The technique of lettering is stressed throughout the course. Mechanical lettering aids and devices such as the "Wrico," "Leroy," and "Rapidograph" instruments are also employed until the student gains proficiency in their use. Some time is devoted to "Inking" lettering and drawings.	100

Engineering Drawing 400
The significance, preparation, and execution of working drawing is thoroughly covered. The prerequisites of production drawing such as dimensioning, fits, surface, finish, screw threads, fasteners, bearings, gears, and other facets of importance are studied and put to use. Design criteria for the various fields in production drawing are analyzed and developed. Stress is placed on product design, jigs, fixtures, punches, and dies, gauges, and electro-mechanical semantics.

Industrial and Manufacturing Standards 150

Drafting room standards, manuals, and industrial magazines are introduced for student familiarization. These include publications of Military and Federal Services, American Standards, American Welding Society, Aerospace-Automotive Standards, American Society of Tool and Manufacturing Engineers, and others too numerous to mention. The student is made aware of the various handbooks and catalogs available in industry and is encouraged to compile his own library, and make use of same.

Industrial Production Processes 150
The student is exposed to manufacturing methods and processes via films, field trips, and study. A knowledge of machining, assembly, and gauging operations as practiced by industry is also gained.

Materials in Design Engineering 50
The composition, properties, and nomenclature of materials are studied with emphasis upon their application in design and engineering.

Technical Mathematics 290
Basic arithmetic review is followed by Technical Mathematics, Algebra, and Trigonometry. Slide rule, logarithms, and the use of tables, charts, and handbooks is interspersed in the course.

Physics 50
The basic fundamentals of Mechanics, Heat, Eletricity, Sound, and Light are presented plus topics and principles on Flight, Atomic Energy, and their physical laws and relationships.

Business English 100
Basic requirements of good writing and composition are reviewed. Included are parts of speech, syntax, punctuation, and other mechanical matters. Nomenclature and practices common to Engineering topics are introduced. Methods of composing "Job Experience Resumes," letters of application, business correspondence and technical writing are also stressed.

Reproduction and Office Machine Equipment Student learns care and use of Diazo type white-printer, Dry photo-copier, electronic and rotary calculators, mimeograph, spirit duplicator, and standard electric typewriters.	50
Field Engineering Student becomes familiar with surveying and topography problems by map drawing and using the engineer's transit and related equipment in the field.	50
Welding and Shop Practice Student is instructed in the use and care of hand tools, minor shop equipment, and gas, arc, and T.I.G. welding machines. Performs simple welds using these devices.	40
Industrial Familiarization Occupational information, personnel relations, employment responsibility and the utilization of talents and opportunities are discussed in order that the student be fully prepared to meet the challenge of his "New Job."	10
TOTAL HOURS	1840

(Cross Validation Study III)

Course Summary: The Mechanical Drafting curriculum is designed to prepare students to enter industrial drafting positions and includes mathematics, physics, study of various machine tools and tool processes, welding and welding application, and other related technical materials. Completion of the course makes it possible to seek employment as detailer, tool layout man, tool designer, etc.

A student successfully completing the first three-quarters of this six-quarter curriculum may receive a Mechanical Draftsman (Detailer) certificate. The sixty-quarter includes two options: the first places emphasis on die design, the second emphasizes jig and fixture design; this makes it possible for the students to specialize in one of the two areas.

Required Course Curriculum: 211 quarter credit hours are required for completion of this six-quarter curriculum in Mechanical Drafting with an option in the sixty-quarter between Advanced Die Design and Advanced Jig and Fixture Design. All listed courses are required:

Continuing Orientation - 1 hour/week (1st quarter)
Health and Physical Education - 3 hours/week (1st, 2nd, 3rd quarters)
Technical Mathematics (Algebra) - 5 hours/week (1st quarter)
Technical Mathematics (Geometry) - 3 hours/week (2nd quarter)
Technical Mathematics (Slide Rule) - 2 hours/week (2nd quarter)
Technical Mathematics (Trigonometry) - 5 hours/week (3rd quarter)
Technical Mathematics (Advanced Algebra) - 5 hours/week (4th quarter)

Communication I - 3 hours/week (1st quarter)
Communication II - 3 hours/week (2nd quarter)
Political Science - 5 hours/week (1st quarter)
Social Science, Man and Society - 5 hours/week (5th quarter)
Basic Metallurgy - 3 hours/week (2nd quarter)
Machine Shop Practice I - 5 hours/week (3rd quarter)
Machine Shop Practice II - 5 hours/week (4th quarter)
Machine Shop Practice III - 5 hours/week (5th quarter)
Mechanics and Heat - 7 hours/week (4th quarter)
Production Practices - 5 hours/week (6th quarter)
Electricity, Sound, and Light - 7 hours/week (6th quarter)

Core Mechanical Drafting Courses:

Basic Mechanical Drafting - 20 hours/week (1st quarter)
Advanced Mechanical Drafting - 20 hours/week (2nd quarter)
Basic Jig and Fixture Detailing - 20 hours/week (3rd quarter)
Jig and Fixture Layout and Design - 18 hours/week (4th quarter)
Advanced Jig and Fixture Design - 20 hours/week (6th quarter option)
Die Layout and Design - 19 hours/week (5th quarter)
Advanced Die Design - 20 hours/week (6th quarter option)
Theory of Welding Fabrication Processes - 2 hours/week (3rd quarter)
Gearing - 3 hours/week (5th quarter)
Mechanics and Strength of Materials I - 3 hours/week (5th quarter)
Mechanics and Strength of Materials II - 3 hours/week (6th quarter)

Job Title: Draftsman, Structural (profess. & kin.) 005.281-018

Work Performed: Receives engineering specifications, data, designs, or preliminary sketches. Analyzes specifications, data, and designs for technical information concerning materials and processes to be utilized on project, mathematical content; or prepares detailed, freehand sketch, based upon data received from rough sketch, for submission to supervisor or engineer to obtain working specifications and data. Computes specifications and data received, using engineering handbooks and mathematical tables, to obtain dimensions for size, shape, strength, specific fits, welds, tolerances, and stress and load requirements of structural members. Determines or ascertains scale to be used by analysis and computation of specifications and data, through consultation with engineer responsible for project, or from specifications and data furnished by chief draftsman. Organizes and arranges data into logical sequence for drafting. Draws and plots detailed graphic representation of data to scale in conformity with specifications, computed dimensions, and spatial relationships, using T-squares, triangles, straight edges, compass, dividers, scribers, and drafting pens and pencils. Delineates and identifies dimensions drawn with engineering symbols and mathematical data. Letters drawing as specified to identify project and component parts, using freehand and/or lettering machine. Checks drawing for compliance with designs, tolerances, fits, accuracy of dimensions, and specifications and purpose of engineer. Brings existing drawings up to date with current changes in material specifications, alterations of designs, or new information pertinent to construction processes. Prepares technical data and compiles facts to be given to customers. Performs related

clerical work to file and locate drawings, index principle and supplementary drawings, and tabulate data and reports. Occasionally, if assigned to carry through on all phases of drafting job, visits work site to collect or check measurements; scans catalogues and construction publications for specifications on materials being used; and searches out pertinent government regulations, codes, and ordinances, which apply to or modify specifications and data to be drafted.

Job Title: Detailer (profess. & kin.) 017.281-034

Work Performed: Examines architectural or engineering drawings. Receives sheets of architectural or engineering drawings from Chief Detailer for review. Examines drawings to become familiar with structure and consider problems common to placing reinforcing bars in forms, using experience and knowledge of industry standard practices. Telephones Job Superintendent periodically to verify construction sequence and determine lead time required to detail, order, fabricate, and ship materials to job site. Prepares placing sheets, bar lists, and bending diagrams. Draws marks, dimensions, and shape of bends used in similar beams, joists and columns on schedule to make drawings clear and complete. Posts data, such as rod dimensions, grades of steel, special bending diagrams, and reference number of drawing on bar list to provide information to Fabricator, Ironworker, and Inspector. Draws special bending diagrams, where typical bends do not apply. Prepares master drawing of reinforcing bar placement and shape. Observes marks on construction plans and locates initial point where construction will begin. Confers with Ironworker Foreman to establish color coding system for identification to facilitate shipping and storing steel bars at job site. Studies framing plan to visualize structural arrangement of steel bars within concrete cover. Measures architectural drawing, using drafting scale to verify structure dimensions. Examines structural dimensions and considers factors such as maximum length which steel bars are sheared, angle of bends, and complexity.

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FACT SHEET

Job Title: Draftsman, Architectural (profess. & kin.) 001.281-010

Job Summary: Prepares clear, complete, and accurate working plans and detail drawings from rough or detailed sketches or notes according to specified dimensions, using drawing instruments for planning and engineering artistic-architectural and structural features of any class of buildings. Checks dimensions of parts, materials to be used, computes strength of materials, beams, trusses and determines relationship of parts of structure to each other and the relation of various parts to the whole structure. Estimates quantities needed for projects and computes cost. Makes freehand drawings of proposed structure when necessary to clarify plans. Inks in all lines and letters on pencil drawings as required. Exercises skill in manipulation of triangle, T-square and other drafting tools. Draws charts to represent statistical data. Draws finished designs from sketches. Utilizes knowledge of various machines, engineering practices, mathematics, building materials and other physical sciences to complete drawings. May specialize in planning architectural details according to particular structural materials used.

Job Title: Draftsman, Civil (profess. & kin.) 005.281-014

Job Summary: Prepares clear, complete, accurate working plans and detailed drawings used in connection with design, construction, alteration, maintenance, and operation of highways, streets, river and harbor improvements, flood control, drainage and sewage disposal systems, lighting and water installations, airport runways, and other civil engineering projects. Determines scale and dimensions to be used in preparing plans and drawings of structural features and land areas.

Job Title: Draftsman, Geological (petrol. production) 010.281-018

Job Summary: Prepares clear, complete, and accurate maps, cross sections, and profiles to show geological formations, strata, and sub-surface conditions. Drafts new base maps and alters existing maps to supply informative data concerning geological formations, mineral right owners, locations of existing and abandoned oil and gas wells, and man-made structures and roads. Assembles and prepares charts, drawings, and graphs for reports and publications.

Job Title: Draftsman, Mechanical (profess. & kin.) 007.281-014

Job Summary: Prepares clear, complete, accurate working plans and detail drawings according to specified dimensions and rough or detailed notes for engineering or manufacturing purposes. Checks dimensions of parts and materials to be used, relation of parts to each other, and relation of various parts to the whole structure. Inks in all lines and letters on pencil drawings. Manipulates triangle, T-square and other drafting tools. Draws charts representing statistical data. Draws finished designs from sketches. Specializes in drafting detailed working drawings of machinery and mechanical devices, indicating dimensions and tolerances, fasteners and joining requirements and other engineering data. Drafts multiple view assembly and sub-assembly drawings as required for repairing and manufacturing of mechanisms.

Job Title: Draftsman, Structural (profess. & kin.) 005.281-018

Job Summary: Prepares clear, complete, accurate working plans and detailed drawings used in connection with design and construction of buildings, bridges, industrial facilities, and other structural projects. Determines scale and dimensions to be used in preparing plans and drawings of structural features. Performs related clerical work.

Job Title: Detailer (profess. & kin.) 017.281-034

Job Summary: Examines architectural or engineering drawings and prepares bill of materials showing number, size, and bending dimensions; prepares detailed master drawings of steel rod placement and shape within forms to reinforce concrete structural members in highways, bridges, sewers, buildings, and other concrete structures.

Effectiveness of Norms:

Validation Sample

Only 68% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-266R norms, 83% would have been good workers. 32% of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the S-266R norms, only 17% would have been poor workers.

Cross Validation Sample I

Only 65% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-266R norms, 78% would have been good workers. 35% of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the S-266R norms, only 22% would have been poor workers.

Cross Validation Sample II

Only 68% of the nontest-selected students used for this study were good students; if the students had been test-selected with the S-266R norms, 79% would have been good students. 32% of the nontest-selected students used for this study were poor students; if the students had been test-selected with the S-266R norms, only 21% would have been poor students.

Cross Validation Sample III

Only 67% of the nontest-selected students used for this study were good students; if the students had been test-selected with the S-266R norms, 73% would have been good students. 33% of the nontest-selected students used for this study were poor students; if the students had been test-selected with the S-266R norms, only 27% would have been poor students.

Applicability of S-266R Norms:

The aptitude test battery is applicable to jobs which include a majority of duties described above.

GPO 901.745

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